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Influence of Abiotic Factors on the Seasonal Incidence of Sucking Pests and Occurrence of Natural Enemy Population in Groundnut Ecosystem

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ABSTRACT

Seasonal incidence of sucking pests in groundnut was studied during *kharif,* 2018 at Agricultural College Farm, Bapatla. The study revealed that seasonal incidence of thrips, *Scirtothrips dorsalis* and leafhoppers, *Empoasca kerri* was initiated during 36th standard meteorological week (SMW) with a population of 0.97 leafhoppers/plant and 1.14 thrips/plant respectively. The population of leafhoppers reached its peak of 7.12 leafhoppers/plant during 38th SMW. The population of thrips reached its peak during 36th SMW with 6.61 thrips/plant. The population of aphids, *Aphis craccivora* was noticed during 40th SMW and reached its peak during 41st SMW with a population of 1.8 and 4.33 aphids/plant respectively. Population of coccinellids and spiders recorded during 36th SMW with a population of 0.18 and 0.32 per plant respectively, and attained their peak during 41st SMW with a population of 2.01 and 1.12 per plant respectively. The results of MLR analysis showed that all the weather variables together contributed to the incidence of leafhoppers (R^2= 0.6929), thrips (R^2= 0.7327), aphids (R^2= 0.3751) and occurrence of coccinellids (R^2= 0.5787) and spiders (R^2= 0.3867).

Key words: *Aphids, Abiotic factors, Coccinellids, Groundnut, Leafhoppers, Spiders and Thrips.*

Groundnut (*Arachis hypogea* L.) is one of the premier oilseed crops of India and tropical and subtropical regions of the world (Gadad *et al.,* 2013). It is cultivated as *kharif* and *rabi* crop on sandy loam and loamy soils and its cultivation confined to countries between 40 ^{0}N and 40 ^{0}S latitudes. In India, it is grown in an area of 7.07 m ha with 8.5 m t production and with a productivity of 1704 kg per hectare (Economic survey, 2017-18).

The factors influencing the yield in groundnut are biotic and abiotic stresses during crop growth period. Pests and diseases are the major biotic stresses that affect the yield. There are about 100 pests, including insects, mites and nematodes and among them the key insect pests include lepidopteran and sucking pests which are considered to be economically important.

Thrips are the major sucking insect pests in groundnut and are known to cause yield loss of 14.0 to 40.0 per cent and are also responsible for spreading stem and bud necrosis viral diseases. Leafhoppers also cause extensive damage and are known to be serious on groundnut crop and their feeding symptoms induce yellowing on foliage that begins at the tip, known as hopper burn. Aphids also cause serious damage in groundnut causing losses upto 40 per cent (Khan and Hussain, 1965). Natural enemies play an important role in keeping the pest population under control due to their potential as biological control agents.

The studies on basic information about on relative occurrence of pests and natural enemy population in relation to weather parameters are necessary for understanding the population dynamics of the pests and extent of damage by them during different growth stages and the influence of various weather parameters on the pest and natural enemy activity to decide a suitable strategy for proper management. Therefore, the present investigations were carried out.

MATERIAL AND METHODS

The present investigation was carried out at Agricultural College Farm, Bapatla during *kharif,* 2018. The groundnut variety TAG-24 had sown at a spacing of 30 x 10 cm to record the incidence of thrips, leafhoppers and aphids. Observations were recorded at 5 days interval from 15 days after germination to maturity stage.

Number of thrips and leafhoppers recorded on three (top, middle and bottom portions) leaves by tapping the leaves on white paper. The number of aphids and natural enemies *viz.,* coccinellids and spiders were taken as number per plant by visual observations.

The data on abiotic factors such as maximum temperature, minimum temperature, RH, rainfall were recorded simultaneously from meteorological observatory available at the College farm, Bapatla and analysed statistically by subjecting previous week weather data with current week pest incidence data to MLR analysis (Gomez and Gomez, 1984).

Table 1. Seasonal incidence of sucking pests in groundnut in relation to weather factors during *kharif*, 2018

Observation Date	Standard week	Temperature(^{0}C)		RH (%)		R.F (mm)	Sucking pests (Number per plant)		
		Maximum	Minimum	Morning	Evening		Thrips *	Leaf hopper *	Aphids *
03-09-18	36	35.58	25.82	71.20	65.80	2.22	1.14	0.97	0.00
08-09-18	36	34.78	26.56	77.40	73.40	0.00	6.61	2.12	0.00
13-09-18	37	35.08	25.72	80.40	77.40	0.06	5.88	6.87	0.00
18-09-18	38	32.12	23.64	85.40	83.60	10.12	4.12	7.12	0.00
23-09-18	38	33.08	25.26	83.00	82.20	0.06	4.59	5.39	0.00
28-09-18	39	33.58	25.34	80.80	80.60	0.42	3.64	4.48	0.00
03-10-18	40	34.06	24.80	84.00	78.40	2.32	5.33	6.32	1.80
08-10-18	41	34.62	24.40	79.20	61.00	0.00	4.12	4.39	4.33
13-10-18	41	34.10	25.58	80.80	81.80	2.96	2.32	3.36	2.12
18-10-18	42	31.38	23.24	85.80	81.00	1.66	1.87	2.38	1.01
23-10-18	43	32.72	22.84	85.20	70.00	0.00	1.02	1.39	0.00
28-10-18	43	32.54	21.80	84.40	73.80	0.00	1.46	1.45	0.00
02-11-18	44	31.00	23.42	85.20	83.60	7.64	0.74	0.96	0.00
07-11-18	45	32.60	22.50	84.80	81.80	0.00	0.94	0.89	0.00

RH = Relative Humidity RF= Rainfall *= Mean data of 50 plants from five locations

Table 2. Multiple linear regression analysis of population of sucking pests and their natural Enemies on groundnut during *kharif*, 2018

Variable	R^2	Multiple linear regression analysis equation
Leafhopper	0.6929	$Y= -145.405+ 1.8920*X_1+ 0.8961*X_2 + 0.7945*X_3- 0.02478*X_4+0.3298* X_5$
Thrips	0.7327	$Y= -103.716+ 0.8793*X_1+ 1.4386*X_2 + 0.5927*X_3- 0.081*X_4+0.0525* X_5$
Aphids	0.3751	$Y= -31.785+ 0.2644*X_1+ 0.444*X_2 + 0.3015*X_3- 0.1574*X_4+0.6115* X_5$
Coccinellids	0.5787	$Y= -33.11+ 0.4130*X_1+ 0.2605*X_2 + 0.2079*X_3- 0.044*X_4+0.074* X_5$
Spiders	0.3867	$Y= -10.1896+ 0.124*X_1+ 0.0853*X_2 + 0.0697*X_3- 0.0154*X_4+0.030* X_5$

X_1 = Maximum temperature ;
X_2 = Minimum temperature ;
X_3 = Morning relative humidity ;
X_4 = Evening relative humidity;
X_5 = Rainfall.

RESULTS AND DISCUSSION

Leafhoppers

The data recorded on population of leafhoppers (Table 1) (Fig. 1) revealed that the initial incidence of *E. kerri* was observed during 36th Standard Meterological Week (SMW) with a mean population of 0.97 leafhoppers per plant. The leafhopper population increased gradually and attained its peak during 38th SMW with a mean population of 7.12 leafhoppers per plant. Later, the population declined gradually up to 39th SMW and the least population of leafhoppers was noticed during 45th SMW with a mean population of 0.89 leafhoppers per plant.

These results are in accordance with the reports of Jyothirmai *et al.* (2002) who reported that peak population of *E. kerri* on groundnut was during mid- September *i.e.,* during 38th SMW.

The data on incidence of leafhoppers was subjected to MLR analysis (Table 2) and the results showed that all the weather parameters together contributed to the incidence of leafhoppers by 69.29 (R^2= 0.6929) per cent. Results indicated that significant positive association between leafhopper population and maximum temperature, rainfall and morning relative humidity. One degree raise in maximum temperature is expected to raise the population of leafhoppers to 1.89.

$$Y= -145.405+ 1.8920*X_1+ 0.8961*X_2 + 0.7945*X_3- 0.02478*X_4+0.3298* X_5$$

These reports are in accordance with Harish *et al.* (2015), who reported that leafhoppers had a significant positive association with maximum temperature in groundnut ecosystems. The population of leafhoppers inflict damage at serious proportions at early stages of crop growth as these insects suck sap from tender leaves and buds causing stunted growth.

Similarly, 1 mm raise in the rainfall was expected to increase the pest population by 0.32 and one per cent increase in the morning relative humidity was expected to raise leafhopper population by 0.79. These reports are in conformity with Singh *et al.* (1974) who reported that heavy rainfall coupled with high humidity was conducive for the appearance and breeding of green leaf hopper population. Similar reports were given by Faleiro *et al.* (1990) on cowpea.

Whereas, a negative non-significant association was observed with evening relative humidity. While, a positive non-significant association was observed with minimum temperature.

Thrips

The data recorded on population of thrips (Table 1) (Fig. 2) revealed that the initial occurrence of *S. dorsalis* observed during 36th SMW and showed a mean population of 1.14 thrips per plant. The population attained its peak population during 36th SMW with a mean population of 6.61 thrips per plant. The raise in the population may be due to increase in the morning relative humidity.

Then the population declined gradually up to 39th SMW with 3.64 thrips per plant followed by slight increase in the population during 40th SMW with a mean population of 5.33 thrips per plant.

The results of MLR (Table 2) showed that all the weather variables together contributed to the incidence of thrips by 73.27(R^2= 0.7327) per cent.

$$Y= -103.716+ 0.8793*X_1+ 1.4386*X_2 + 0.5927*X_3- 0.081*X_4+0.0525* X_5$$

Results indicated that significant positive association between population of thrips and minimum temperature and morning relative humidity. One degree raise in minimum temperature is expected to raise the population of thrips to 1.43. These reports are in harmony with the reports of Naresh *et al.* (2018) and they reported that the population of thrips showed positive association with maximum and minimum temperature. Similarly, one per cent increase in the morning relative humidity was expected to raise thrips population by 0.59. Similar reports were given by Vijayalakshmi *et al.* (2010) that thrips showed a significant positive relationship with morning relative humidity.

Whereas, a negative non-significant association observed with evening relative humidity. While, a positive non-significant association observed with maximum temperature and rainfall. The results indicated prevalance of thrips noticed throughout the cropping season.

Aphids

The data recorded on population of aphids (Table 1) (Fig. 3) revealed that there was no incidence up to 39th SMW. The initial occurrence of *A. craccivora* observed during 40th SMW and showed a mean population of 1.8 aphids per plant.

The peak population was noticed during 41st SMW with 4.33 aphids per plant. The population of aphids disappeared after 42nd SMW.

The data on incidence of aphids was subjected to MLR analysis (Table 2) and
the results showed that all the weather variables together contributed to the aphid incidence by 37.51(R^2= 0.3751) per cent.

$$Y= -31.785+ 0.2644*X_1+ 0.444*X_2 + 0.3015*X_3- 0.1574*X_4+0.6115* X_5$$

Results indicated positive non-significant association with maximum, minimum temperatures, rainfall and morning relative humidity, whereas negative non-significant association with evening relative humidity.

These results were in accordance with the findings of Hariprasad (2007) for all the weather parameters except for morning relative humidity in which he observed negative non-significant association between the incidence of aphids and morning relative humidity.

Coccinellids

The data recorded on population of coccinellids (Table 3) (Fig. 4) revealed that the initial occurrence of coccinellids observed during 36th SMW with a mean population of 0.18 coccinellids per plant. The population attained its peak during 41st SMW with a mean population of 2.01 coccinellids per plant. The population of coccinellids declined by 43rd SMW with a mean population of 0.10 coccinellids per plant. The data on incidence of coccinellids was subjected to MLR analysis (Table 2) and the results showed that all the weather variables together contributed to the incidence of coccinellids by 57.87(R^2= 0.5787) per cent.

$$Y= -33.11+ 0.4130*X_1+ 0.2605*X_2 + 0.2079*X_3- 0.044*X_4+0.074* X_5$$

Table 3. Seasonal occurrence of natural enemies in groundnut in relation to weather factors during *kharif*, 2018

Observation Date	Standard week	Temperature(0C)		RH (%)		RF (mm)	Natural enemies (Mean number per plant)	
		Maximum	Minimum	Morning	Evening		Coccinellids*	Spiders*
03-09-18	36	35.58	25.82	71.20	65.80	2.22	0.18	0.32
08-09-18	36	34.78	26.56	77.40	73.40	0.00	0.42	0.56
13-09-18	37	35.08	25.72	80.40	77.40	0.06	1.76	0.98
18-09-18	38	32.12	23.64	85.40	83.60	10.12	1.15	0.84
23-09-18	38	33.08	25.26	83.00	82.20	0.06	0.92	0.78
28-09-18	39	33.58	25.34	80.80	80.60	0.42	0.92	0.44
03-10-18	40	34.06	24.80	84.00	78.40	2.32	1.28	0.60
08-10-18	41	34.62	24.40	79.20	61.00	0.00	2.01	1.12
13-10-18	41	34.10	25.58	80.80	81.80	2.96	0.62	0.64
18-10-18	42	31.38	23.24	85.80	81.00	1.66	0.32	0.44
23-10-18	43	32.72	22.84	85.20	70.00	0.00	0.24	0.38
28-10-18	43	32.54	21.80	84.40	73.80	0.00	0.10	0.41
02-11-18	44	31.00	23.42	85.20	83.60	7.64	0.45	0.62
07-11-18	45	32.60	22.50	84.80	81.80	0.00	0.34	0.58

RH= Relative Humidity RF= Rainfall *= Mean data of 50 plants from five locations

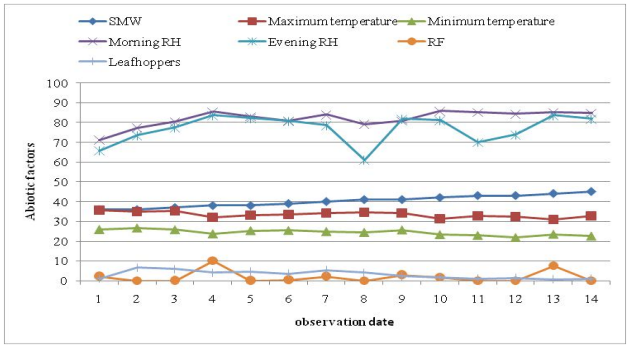

Fig 1. Influence of weather factors on incidence of leafhoppers in groundnut during *kharif*, 2018

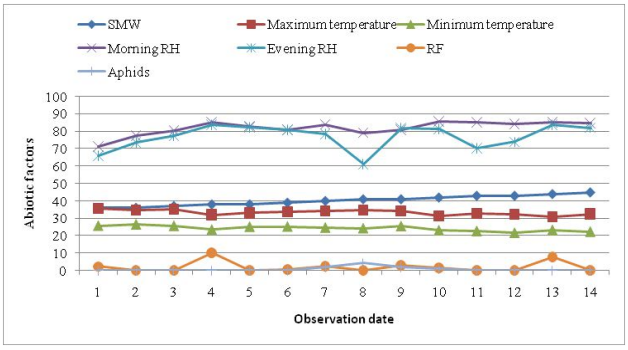

Fig 3. Influence of weather factors on incidence of aphids in groundnut during *kharif*, 2018

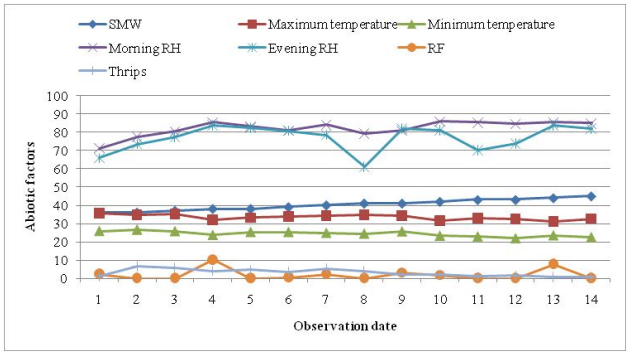

Fig 2. Influence of weather factors on incidence of thrips in groundnut during *kharif*, 2018

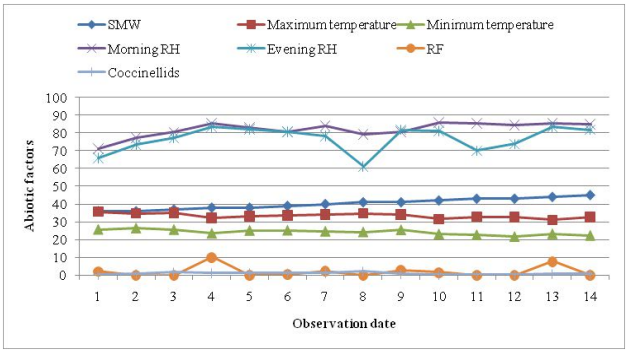

Fig 4. Influence of weather factors on occurrence of coccinellids in groundnut during *kharif*, 2018

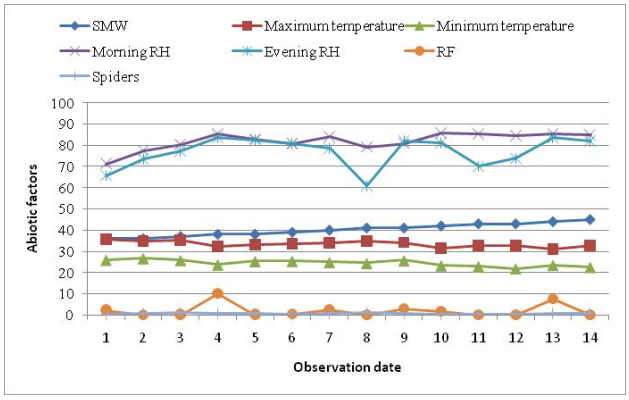

Fig 5. Influence of abiotic factors on incidence of spiders in groundnut

Results indicated that significant positive association between coccinellid population and morning relative humidity. One per cent raise in morning relative humidity is expected to raise the population of coccinellids to 0.20. Faleiro *et al.* (1990) and Hariprasad (2007) observed negative significant association between coccinellids and morning relative humidity in cowpea.

Whereas, a positive non-significant association was observed between coccinellids and maximum temperature, minimum temperature and rainfall. These reports are in agreement with findings of Satyanarayana *et al.* (2009) and Hariprasad (2007) who observed positive non-significant association with maximum temperature and a negative non-significant association with evening relative humidity. The results indicated that there is reduction in the population of sucking pests from 40th SMW due to raise in the coccinellid population.

Spiders

The data recorded on population of spiders (Table 3) (Fig. 5) revealed that the initial occurrence was observed during 36th SMW with a mean population of 0.32 spiders per plant. The population attained its peak during 41st SMW with a mean population of 1.12 spiders per plant.

The data on incidence of spiders was subjected to MLR analysis (Table 2) and the results showed that all the weather variables together contributed to the incidence of spiders by 38.67(R^2= 0.3867) per cent.

$$Y= -10.1896+ 0.124*X_1+ 0.0853*X_2 + 0.0697*X_3- 0.0154*X_4+0.030* X_5$$

Results indicated that non-significant positive association between spider population and maximum temperature, minimum temperature, rainfall and morning relative humidity. These results are in agreement with the reports of Satyanarayana *et al.* (2009) who observed a positive non-significant association between spider population and maximum temperature and morning relative humidity in groundnut.

Whereas, a negative significant association was observed with evening relative humidity. One per cent raise in the evening relative humidity will reduce the spider population by 0.01.

CONCLUSION

The summary of results revealed that the peak activity of thrips and leafhoppers was noticed during the vegetative stage and aphids at reproductive stage. The population of natural enemies initiated during vegetative stage of the crop and their peak population were noticed during the reproductive stage. The results of multiple linear regression analysis revealed that there was a significant positive association between leafhopper population and maximum temperature, rainfall and morning relative humidity. Significant positive association was observed between population of thrips and minimum temperature and morning relative humidity. All weather parameters found non-significant with population of aphids. A significant positive association was observed with morning relative humidity and coccinellid population and negative significant association was observed with evening relative humidity and spider population.

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